

## NOTES ON CALIFORNIA FUNGI

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The last two seasons, so far as weather conditions are concerned, have been anything but ideal. A long-continued drought was the direct cause of failure to secure many species that ordinarily are very plentiful. Again, the scattered storms have induced growth among some species over a most unusual length of time.

To one who is familiar with climactic conditions it would readily be seen that a long season with the fungi is hardly to be expected. Especially is this true when it is known that the dry season is very long, and never broken by summer showers such as are known in the eastern and northern states. Yet, under these dry conditions, one may be able to find many rare specimens of hypogaeous fungi as well as species of Hymenomycetales.

The active work in this investigation was begun in the fall of 1916, and has been continued steadily ever since, including constant observation of the districts to be worked, throughout the entire dry, dormant summer season. The work itself was planned, so far as possible for one man, to include a thorough search over definite regions, and to collect systematically all species found. Thus it was hoped to establish the complete range of species and also the duration of seasons. Special attention was to be devoted to certain classes, such as the Boletes, to solve the really complex problem of their relationship to eastern and European species; to really find out what species are found in this state.

Again, the Hymenogastrales and Tuberales, especially the latter, were to receive a most thorough investigation.

The results considered in this article were obtained only by persistent work under adverse and trying conditions. The amount of time devoted to exploring has been limited to one day in ten this last season, often after having worked all night, and in the face of winter storms. I have ridden over one thousand

miles on a bicycle, carrying a pack and a small rake. I have been taken for a game poacher and a fish shooter, and in one place was persistently hunted as a spy.

Notes and records are made with all material taken. Copies of the notes accompany the specimens, which are all sent to the Department of Botany at Berkeley, California, and there finally classified and preserved in the herbarium or dispatched to various specialists.

To say the least, the work is both arduous and intensely interesting. One who would engage in such a survey must be prepared to encounter and overcome many difficult situations. It is not all rambling over pretty meadows and fine wood-bordered roads. I have ridden many miles over the finest highways in the world, and also over miles of bad roads, railroad ties, and by-paths.

In the fall of 1916 we were favored with some very early rains that were sufficient to start the early fungi. It was, however, well into November before operations began. This first trip was made into the Santa Cruz Mountains, known to be very rich in Boletes. The trip was taken with the idea of a general survey of the district rather than any considerable amount of collecting. A cold snap set in, and the result was that very little material was visible in condition to be gathered. There was, however, evidence of an amazing variety of Agarics as well as several species of Boletes. A few specimens were taken, but nothing of special interest was noted except the enormous quantities of a large white *Tricholoma*. By way of extreme contrast, this same region, for the fall and winter of 1917-18, has been absolutely barren of this species. In fact, this season, there was not a hundredth part of the fungi seen in the previous year.

However, there was one discovery of considerable interest, and that was the finding of two individuals of an apparently new *Boletinus*. There are no descriptions to fit it, and constant watch is now kept for any recurrent plants. Nowhere else, search as I would, could I discover another specimen. Growing among dry, brown leaves, they are hard to distinguish, as the surface of the pileus is chocolate-colored and very deeply cracked or furrowed, and it measures some five to seven centimeters across.

Beneath, the tubes are very large, angular and dirty white; in fact, they are the largest in width of any species yet seen. The stipe is short, thick and lateral, with tubes decurrent. It is solid, tough and concolorous. When first seen the plant appears to be sessile, and altogether very unique.

Successive weekly trips were made to this location for some time, but no results were obtained until late in the spring after a long, cold winter, broken by one storm of exceptional duration and precipitation.

Late in March I visited the locality for the last time during the season, and within a few feet of the place where the *Boletinus* was taken, I found several specimens of *Gyromytra* which resemble *G. esculenta* very closely, but are apparently distinct. The fall of this year, upon one of my first visits, I was again surprised on the same spot with a single *Boletus* of large dimensions, and distinct from any species ever seen here. It was not in perfect condition, however, the large stipe being nearly severed by larvae.

The pileus was very conspicuous, being a brilliant red color, and covered with a dense jelly several millimeters in thickness. It was circular, broadly expanded, margin thick and even, with thick white flesh that turned slowly to a dirty-blue when broken. This flesh was not infested with larvae, the short yellow tubes but slightly so, and the stipe was almost totally destroyed. Like so many others, this last year, but a single plant was found. It is this search for the rare species that lends zest to the work and pleasure in the constant new discoveries resulting from intensive application to it. There is sport and excitement for the lover of outdoor life.

For some time during the winter of 1916-17, I made frequent trips to a region just about six miles south of San Jose, to what is known as the New Guadalupe Mines. The topography of the country is interesting from many points of view. That particular portion which I was then interested in, and still have under observation, was a long, low ridge or two, very heavily wooded on the eastern slopes with a second growth of Coast Live Oak, *Quercus agrifolia*. It was the very nature of this growth that invited careful investigation. Many trips were made, and ex-

plorations extended all over this district, but with little results. I became very much discouraged at repeated failures here, as I had hope of securing some Tuberales and Boletes. Going over this ground was exceedingly hard work. I was led to return to this region mainly by noticing the work of the wood rats. And it was by watching the holes dug into hard ground, often a foot deep, that led finally to making some real discoveries.

This locality yielded me some very good specimens for instruction work; especially was this true of the common *Chanterelle*. This especially desirable fungus was absolutely unknown here until I exhibited some specimens from the coast, where it is very abundant. On this side of the mountains it is not very often found, and I hunted several seasons for it, finally securing specimens at Guadalupe. Several fine species of *Clavaria* were also used for exhibition and instruction, as they were also unknown here.

I spent literally hours upon hands and knees in crawling through thickets and raking over the leafy deposits, and on one occasion I thus turned up a very peculiar specimen of *Thelephora* which was sent to Professor Burt for determination, as no description could be found to fit it. This is an instance where no definite location could be fixed that would be a guide to additional material; growing on the ground, covered with leaves and of itself inconspicuous.

On another day I came upon two specimens of *Amanita* growing close to the bole of a live-oak. They were exceptionally large, and symmetrical in proportion. Tinged with crimson, they seemed to fairly radiate with color. I turned them in as belonging to the *rubescens* group, but from what descriptions were available they seem a new and distinct species. This difference from published descriptions, or the entire lack of such descriptions, has been one of the strong incentives to the work now in hand.

Persistence had its reward, and on a trip to "The Call of the Wild" in the Santa Cruz Mountains I came upon a grove of pines in which a dense mat of débris had collected for years. I secured some good material of *Hydnangium carneum* on top of the ground, but under some six inches in this mat of needles. At the same time I secured specimens of a form that will certainly puzzle one when first found, for it has the appearance of a young *Co-*

*prinus micaceus*. The pileus is well developed, but the stipe appears to be undeveloped. Then, too, one sees the pseudo-lamellae and hardly knows what to expect until it is cut open.

Quite strangely, in reporting these specimens, I used almost the same words in describing them as did Dr. Setchell, who described and named this and another species as having been found at Berkeley in 1907; the one I found being somewhat common, the latter rare.

These two are species of the widely distributed, but uncommon genus, *Secotium*, about which there seems to be very little known. The species found as noted above is described by Dr. Setchell as *S. tenuipes*, and anyone having seen his paper cannot mistake this very remarkable fungus.

The other species named by him is even more remarkable, in its imitation of a young, red-capped species of *Russula*, and because of this resemblance it is known as *Elasmomyces russuloides*. It had up to this time proved to be quite rare, and was reported only from Berkeley, California.

During an extended trip to the coast, but only about twenty miles from the above location, late in May of 1917, I came upon a single specimen under a thin covering of laurel leaves. Seen from above, one would invariably take it for a *Russula* unless the description was known, and then only the conspicuous pseudo-lamellae would reveal its true character. It is a small plant, from two to five centimeters across the pileus, but very attractive.

When I resumed my explorations this spring in the original locality, I persistently encountered this last species, it proving to be quite abundant; so for a time I passed these forms by until some were needed for exhibition at the Wild Flower Fête. I had noticed an occasional form where the hymenium was entirely closed, but still a very definite stipe was present, and the color was almost pure white with no touch of the red. It now seems that I probably have a new form of *Elasmomyces*, as Dr. Setchell has announced very distinct characters for this new form, but more material should be at hand. However, this plant is neither of the two *Secotiaceae* previously described by him. Casual observation will often leave many fine specimens untouched because

of an external similarity. Another season should develop some definite knowledge of these peculiar forms.

A few days after my discovery of the *Secotium* at Alma, I went again to the Guadalupe district, and secured after a great deal of hard work some specimens of a *Melanogaster* which so far seems well known and is quite common but as yet is unnamed. I have since collected it frequently and find it very interesting. It is a small, dark-brown or black growth, sometimes covered with a dense, brown, powdery substance that of itself would be a distinctive characteristic. I have found it averaging the bulk of a good-sized marble, and rarely up to the size of an egg and nearly round. It is most frequently found just under the leaves, but I have also discovered it over six inches deep in hard ground, and much wrinkled.

And there is still another strange thing about this fungus. Under coast live-oaks are favorite places for it, especially if the leafy deposit is heavy. Turning these leaves over, the little brown balls are exposed and are seen to be covered with great drops of moisture; and I have found them so day after day during many weeks, and in places where no rain had fallen for many months. As they mature, they become soft and in a way deliquesce. Really, the upper half falls away, exposing the interior, which has melted to a tarry consistency and then run away, carrying the ripe spores into the ground. When first exposed these little plants are often covered with a fine yellow mycelium, but no special point of attachment is seen and older plants do not show it.

It is common, but also very distinctive,—withal a plant not to be tolerated as a familiar companion unless thoroughly dried in the open air or securely pickled.

It seems that the Hymenogastreales are more or less to be associated with powerful aromatic properties, some of which are pleasant, but others powerfully offensive. And this particular *Melanogaster* is the most offensively pungent of them all. While maturing, if left in a room, it will be so strong in an hour's time as to be sickening. I do not wonder that botanists familiar with it find it difficult to select an appropriate name. Certainly, seeing it as I have, none of the offensive names fit; it would take them all and that would not be enough.

This plant is a favorite with the rodents—the wood rats search for it persistently. I have been able to detect it a long distance on a quiet day when the odor penetrates the woods while rats eat it. Proving this to a skeptic this last season afforded much amusement, and also added proof of its qualities. A visitor accompanied me on one occasion in May to this region, and in the woods I soon detected this odor and called attention to it. It was so strong that my friend noticed it, and was able to work down wind to its source under my direction until I pointed out the freshly turned ground and leaves. I induced him to dig among the leaves and he soon found the *Melanogaster*. It seemed almost unbelievable that such a small object could be so pungent.

On this latter occasion, I secured in the débris of a rat's nest a different species, larger, and covered with a very dense golden to reddish powder. Since then I have gathered two additional species, none with the evil odor. The different species are easily distinguished by their reaction in alcohol, the former turning a deep eosin-red, and the others changing according to the color of their powder or spores.

Referring to these strong odors so characteristic of the Hymenogastraceae, I have found other genera very offensive when carried about in a collection, and this is true particularly with reference to species of *Hysterangium*, while *Rhizopogon* and *Gautieria* are also reported as very powerful. But some species are negative or mild; at least one *Gautieria* is very pleasant and others are bad only after being confined in a collecting case. Both the *Hysterangium* and the *Gautieria* are favorites of the wood rats, and the smell is easily identified at a long distance when the rats are feeding upon them.

Still in a persistent search for truffles, and loath to give up my location at Guadaloupe and seek other ground, I renewed my quest two days after finding the first *Melanogaster* in that vicinity. This took me into the very heart of a dense manzanita thicket, where progress was upon hands and knees. I shortly became involved so completely in the tangle that further progress was impossible. I came to a stop at a huge rat's nest built around an enormous manzanita, and had actually seen the occupants digging for some fungi around its very base. There was noticeable

a very pleasant woodsy odor that I later identified with the fungi they were eating. I found easily one fresh hole about twelve inches in depth in hard soil and could see at the bottom a half eaten fungus. This I secured and found that it was fully as large as an egg. The plant was not plentiful, but after much hard work I secured a total of seven, all deep in hard ground at the base of this nest. They proved to be a species of *Gautieria*. Two species are reported from this state by Dr. Harkness, but they seem to be very rare.

This species possesses an exceedingly powerful smell, which is rather pleasant and easily recognized. The specimens collected were in my possession for a short time, and although securely wrapped and boxed for shipment to Berkeley, they gave off so strong an odor that the house retained traces of it for several days. I have formed a theory of a certain relationship between these hypogaeous forms and the location of rat's nests, and I have so far seen it fairly well verified, for where the fungus is plentiful there the rats are also plentiful, or it may be the other way round.

Within a few days in this same locality, I made a deliberate test of this theory, and without much difficulty after getting a scent I went directly to a small nest in some poison oak and secured three very fine plants. Twice this season I tested the theory, and secured specimens at "The Call" without trouble. On another day when collecting had been very good, and I had overstayed my time at Guadaloupe, as I was making a very hasty departure, going through these same woods, I was attracted by what appeared to be a very fine, large puffball with a white peridium. I reported it as such and created considerable excitement, for it proved to be another *Gautieria* having a peridium at maturity.

These *Gautierias* have been examined by Professor Zeller, who pronounces them *G. morchellaeformis* and *G. Trabuti*.

March 31, 1917, proved to be a day full of excitement. Professor Setchell reported the day's collection as "amazing," and, when one considers the results obtained, it was most gratifying to me. It was on this day that I found the above *Gautieria* with a peridium. I was still at work on the Guadaloupe district, and had spent an entire morning in the thick woods without results.



At noon I decided to cross to the opposite hillside with its scattered oaks of very large size.

Under a single large tree on a very steep slope, I found a dense mass of leafy humus overlying fine, loose, dry soil. I found a few small *Pezizas* and was encouraged to look farther. When I finished it was nearly sundown and not a foot of soil under that tree had escaped search. On one side was the débris of a rat's nest. The first find of importance was a few small, brown tubers, at first referred to *Tuber candidum*, several specimens of *Genea arenaria*, *Hydnотrya ellipsospora*, *Hydnотryopsis Setchelli*, and some others. This was the first collection of truffles, and it now seems that the brown tuber is an unreported species—certainly not *Tuber candidum*, but I have not found it this season of 1918. Many specimens were found both here and at the other location, but very few contained mature spores. I also found them on the coast side of the mountains. *Genea arenaria* is fairly well known, and is well described by Dr. Gilkey in her Revision of the Tuberales of California. Of *Hydnотrya*, but a single specimen had been found in December, 1909, at Pacific Grove. During the season I added nearly a dozen plants to the collection. *Hydnотryopsis*, likewise, was known only by very scanty material, but Dr. Gilkey gave me personal assurance that material sent in that day was sufficient to confirm her description in every detail made from long preserved material in the Harkness collection.

On April 15 I secured another tuber which promises to be in a new genus close to *Piersonia*, according to Dr. Gilkey, but more material must be had if possible. In a good collection made the last of May and examined by Dr. Gilkey, there seems to be another genus which she says is intermediate between *Geopora* and *Hydnотryopsis*, but for the time being the specimens are referred to this latter genus.

I have made frequent reference to the wood rats and their nests, and it is well to explain that in many cases I have been well rewarded by operating around them. The rotten wood and decomposed material that settles around them seems to create ideal conditions for growth of hypogaeous fungi. When one considers the very large number of specimens taken in 1917, as well as the

wide range of species found in close proximity, others may, in searching for such forms, well pay close attention to such places.

How well I was repaid for this observation was shown on April 17, when I was again in the Guadalupe district. I found some sixty odd specimens of Tuberales, including *Genea*, *Hydnotrya*, four species of *Tuber*, and some others not as yet identified as to species. The one remarkable feature of these tubers was that there were twenty-five of the brown ones found on March 31. It now began to appear that this was not *Tuber candidum*. I found it in many places during the next two months, and a large amount of material is on hand for the specialist to work over.

*Tuber candidum* was not found until late in May. The two species are very much alike in size, shape, and color, but my brown tuber is of a solid brown, easily distinguished from *T. candidum*, which has an almost pinkish cast. Both are slightly cracked in radiating lines, with solid, white meat, very sweet and nutty to the taste, but having no particular aroma.

Much additional material was added this season, but nothing like the quantities found last year, although the brown tuber has not been seen. Some very puzzling forms have been found, but not sufficient to be of much value. Two, however, are worth mentioning. One, a single specimen previously reported only from Placerville by Dr. Harkness; the other apparently a new form of *Hydnocystis*, since Dr. Setchell pronounces it not *H. Californica* and this is the only species referred to as Californian by Dr. Gilkey.

On April 15, 1917, I was making an effort to secure more *Gautiera* with a peridium, and toward the close of the day I had worked into the old tangle of manzanita, where I secured a large collection of a white fungus that seemed upon examination to be what I wanted. It proved, however, to be a species of *Hydnangium*, and new to Dr. Setchell. Whether or not it is a described species has not yet been determined.

Another genus not very well known has proved of exceptional interest this year, and this is *Hysterangium*. During the season of 1917 I came upon scattered plants of a single species, with a white peridium and a very tough, gristly interior. This is a verdigris-green-spored species with a most offensive smell. Once

seen, this plant is not easily forgotten. I encountered it quite unexpectedly this season and have been able to study it rather intimately. As the genus seems to be little known, I shall go into some details of its growth and appearance.

It is truly hypogaeous and a gross feeder upon the forest débris, and may be found in all kinds of forests. It prefers no one species of tree, and I have found it equally plentiful under redwoods and live oaks. As one gets into this work, it becomes possible to identify some of the genera by the appearance of the mycelium encountered before the spore-body has been seen. *Hysterangium* is the easiest to identify and is unmistakable.

This mycelium is white, coarse, and in dense mats often several inches thick and extending over many square feet. In fact, the extent of these mycelial beds is enormous. I have been able to gather sheets of it that looked like lace. The sporophores average at maturity 2.5–3 cm. in diameter, and are nearly round, with a thick, white peridium that turns brown when handled or exposed to the air. This peridium breaks easily and separates from the context. The interior is a tough, green, gristly substance in the center of which there appears to be a well-lined cavity.

I came upon a bed of mycelium in a redwood forest in January last, and followed it to its limits and roughly measured its extent at 500 square feet—I believe this was conservative. In fact, on almost any place within a quarter of a mile on that hillside, this species could be found. The young plants are in a network of this mycelium, but, as it reaches maturity, the threads disappear, leaving the plant near the surface, where it slowly decomposes. I never failed to find this species in quantities, and soon gave up collecting it.

Late in March I was close to this locality, but working along the edge of a grove of live oaks for tubers, when I encountered a bed of this mycelium, and directly I came upon several huge specimens—some as large as eggs. I had found an end of the bed and started to trace its extent. It was less than two feet in width, in gravelly soil, and about every four feet I came upon a cluster of closely crowded, distorted, huge plants. Shortly it entered dense brush, and the spore-bodies no longer appeared. I was able to trace this narrow bed for over two hundred feet, and

then quit in a dense thicket. It never varied from its straight course. The tubers were green-spored but not offensive; the peridium separated more readily, and the central cavity was not present. Radiating from the base were streaks of a gristly substance different in color from the context.

Subsequently, I encountered another extensive bed of a huge species, but the context was purplish at first, later turning to a raw-beef color with streaks of gristle in it. And, still later, I found another of the green-spored species, which was very small. All the others had the white peridium usually separating readily, but in this last species the peridium proved to be very tough. There is considerable material on hand for study, but more is desired and will be sought this coming season.

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